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(71)(72) Applicant and Inventor: HUTSON, William, H. [US/US]; 47 Grange Avenue, P.O. Box 221, Little Compton, RI 02837-0221 (US).	
(74) Agents: KENNARD, Wayne, M. et al.; Hale and Dorr, 60 State Street, Boston, MA 02109 (US).	

(54) Title: A METHOD AND SYSTEM FOR REAL-TIME INFORMATION ANALYSIS OF TEXTUAL MATERIAL

(57) Abstract

A multi-dimensional processing and display system to provide a system by which large volumes of textual data may be efficiently sorted and searched. Textual data input to the multi-dimensional processing and display system is from one ore more documents that are reformatted and translated into one or more numeric matrices. The matrices are modified to enhance and/or suppress certain words, phrases, subjects, etc.. Thereafter, a single two-dimensional data is formed by concatenating the numeric matrices. The multi-dimensional processing and display system creates and maintains a historical database which is also concatenated in the two-dimensional matrix. Once the textual data is in the form of a two-dimensional matrix, the data can be analyzed efficiently, for example, using singular value decomposition. In doing so, the two-dimensional concatenated matrix is decomposed to obtain a compressed form of the numeric matrix. Certain data elements in the two-dimensional matrix may be enhanced, while certain other data elements may be suppressed. After data enhancement and/or suppression, the two-dimensional matrix is partitioned and rearranged to form an enhanced multi-dimensional matrix. All or portions of the enhanced multi-dimensional matrix are then visually displayed.

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A METHOD AND SYSTEM FOR
REAL-TIME INFORMATION
ANALYSIS OF TEXTUAL MATERIAL

5   Related Applications

The present application is a continuation-in-part of U.S. Patent Application
Serial No. 08/119,362, filed September 10, 1993, which is a continuation of U.S. Patent Ap-
plication Serial No. 07/978,245, filed November 18, 1992, now U.S. Patent No. 5,245,587,
which is a continuation-in-part of U.S. Patent Application Serial No. 07/628,337, filed De-
10   cember 14, 1990, now U.S. Patent No. 5,175,710.

Field of the Invention

The invention relates to computer-based analysis and information retrieval
and, in particular, to the rapid access, analysis, and visualization of only desired textual ma-
terial stored in computer files.

15   Background of the Invention

Recent advances in digital communications and computer storage capacity,
and processing power have provided the user with ever-increasing access to vast amounts
of textual and other types of data. This also has created an increasing need to reliably sort
such data for desired information it contains. This need for efficient sorting of data is ever
20   more important because as the amount of textual data increases, the sorting of such textual
data increases exponentially.

The problem described above is not solved by faster computer processors
and more efficient computer storage. In fact, these suggested remedies only compound the
problem.

25   As there is increasing access to larger amounts of data, it may overload the
ability to effectively process such information for use. In fact, this massive increase in data
may result in a form of "data pollution." Thus, while a potential user may be interested in a
subject, he or she may not have the time, resources, nor inclination to read through the ex-
tremely large number of articles on the subject. What they actually desire is to obtain the
30   basic information on a subject and then any additional articles that present new or different
information on the subject of interest.

To properly access a database today, a user needs to explicitly formulate and
specify highly structured inputs. Often, it is necessary for a user to be trained in how to use

1   a particular database retrieval system. That is, how to formulate a proper query, and what
words or phrases to use to efficiently access the database. Unfortunately, the focus often be-
comes the database retrieval system itself, rather than the information it contains. The larger
the database, the less likely a casual user is able to get the information he or she actually
5   desires, at least not without considerable difficulty.

Noting the above, improvements in database retrieval systems gives us ac-
cess to larger amounts of information, but this access can quickly result in information over-
load. Moreover, the user's unfamiliarity with particular computer systems also results in
incorrect choices of keywords, improper specificity of semantic relationships, or inexact
10   context descriptions. A user, therefore, is often inundated with large amounts of redundant
and often worthless information.

The present invention overcomes these problems as demonstrated in the re-
mainder of the specification and the attached drawings.

Summary of the Invention

15   The present invention is a multi-dimensional processing and display system
that is used with textual data in machine-readable form, e.g., ASCII text files, optical char-
acter recognition of scanned textual material, speech recognition of acoustic information,
etc.

Textual data that is input to the multi-dimensional processing and display
20   system of the present invention is from one or more documents that are reformatted and
translated into numeric form and placed in one or more matrices. The matrices are modified
to enhance and/or suppress certain words, phrases, subjects, etc. This multi-dimensional
matrix form of textual data is then separated into a number of matrices of two-dimensional
data which are concatenated together along a common dimension to form one large two-
25   dimensional matrix.

The multi-dimensional processing and display system of the present inven-
tion creates and maintains a compressed, historical database which is also concatenated
with the two-dimensional matrix. This database allows certain lexical, semantic, and/or tex-
tual constructs to be enhanced and other constructs to be suppressed.

30   Once the textual data is in the form of a two-dimensional matrix, the data
can be analyzed efficiently using, for example, singular value decomposition (SVD). The
two-dimensional concatenated matrix is decomposed to obtain a compressed and enhanced
form of the numeric matrix. In the preferred embodiment, singular vectors and singular val-

1 ues are obtained. Singular vectors are partitioned into one or more groups on the basis of their corresponding singular values, or other selected criteria.

One or more groups of the singular vectors are analyzed further to deter-5 mine, analyze, and identify semantic, lexical, and/or textual constructs of interest. Selected singular vectors may be compared with prior results, or be "searched," for example, in the form of a database query.

Certain data elements in the two-dimensional matrix are enhanced, while certain other data elements are suppressed. In the preferred embodiment, this is accomplished by modifying the singular values within each of the groups of singular vectors to 10 enhance certain lexical, semantic, and/or textual constructs and to diminish other features within the textual data.

An enhanced, two-dimensional matrix is generated by multiplying together the diagonal matrix of modified singular values and singular vector matrices. The two-dimensional matrix has enhanced data values associated with certain lexical, semantic, and/ 15 or textual constructs of interest.

After data enhancement, the two-dimensional matrix is partitioned and rearranged to form an enhanced multi-dimensional matrix. All or portions of the enhanced multi-dimensional matrix are then visually displayed. The preferred embodiment displays lexical, semantic, and/or textual constructs of interest as opaque objects within a three-di-20 mensional transparent data cube, enabling a user to review many documents quickly and easily.

It is an object of the present invention to rapidly access subject material, and be able to continually and efficiently absorb information, yet enable a user the opportunity to review new material on a topic without having to read and sort through many similar tex-25 tual articles.

It is another object of the present invention for a user to use common and flexible forms of input to guide data queries, such as a brief description, a related article, or a portion thereof.

It is a further object of the present invention to continuously input textual da-30 ta, analyze it, sort through it for pertinent information and important relationships, and "digest" it for later analysis and retrieval.

A still further object of the present invention is for a user to rapidly visualize material to quickly assess its importance and where to look to find information of interest.

1   A yet further object of the present invention is to enable a user to have gen-
eral access and utilize familiar means of identifying subjects of interest, to be able to inter-
actively modify, change, and exclude information in his or her search and to quickly see the
results of these changes.

5   Brief Description of the Drawings

           Figure 1 shows a text document and its corresponding structured and numer-
ic matrices.

           Figure 2 shows multiple documents arranged as a stack of two-dimensional
matrices.

10   Figure 3 shows the singular value decomposition of a concatenated, numeric
matrix, X.

           Figure 4 shows the flow diagram for operation of the system of the present
invention.

           Figure 5 shows the flow diagram of the Preprocessing Function.

15   Figure 6 shows the historical database of features of interest and features not
of interest.

           Figure 7 shows the flow diagram of the Subspace Processing Function.

           Figure 8 shows the flow diagram of the visualization Analysis Function.

           Figure 9 shows visualization and interpretation of results.

20   Figure 10 shows a database query.

           Figure 11 shows another form of database query and identification of new
information.

Detailed Description of the Drawings

           The present invention is a "real-time" data retrieval system that may be con-
25   tinuously updated as new textual information becomes available. The present system pro-
cesses input textual data in real-time, analyzes it, reduces or eliminates unwanted data, and
enhances lexical, semantic, and/or textual features of interest.

           Referring to Figure 1, the original text document is on the left, its semanti-
cally and syntactically modified form, T_s, is in the middle, and its converted, numeric form,
30   N, is on the right. The semantically and syntactically modified form of the original docu-
ments, T_s, is converted into matrices T_s and N that have the dimensions sentence structure
by position within the document. Specifically, each row in the matrices correspond to a sen-
tence. It is contemplated, however, that alternative embodiments may use other structural

1   constructs.

Referring to Figure 2, multiple documents may be transformed into matrices and stacked to form a three-dimensional matrix, with the dimensions sentence structure determined by position by document. Although the documents in Figure 2 are the same length

5   and width, other embodiments may have documents with variable dimensions.

In Figure 3, in general, the textual data from Figure 2 is rearranged and concatenated together along with historical information, H, into a single, two-dimensional matrix. Singular value decomposition (SVD) is used to decompose the matrix into its lexical, semantic, and/or textual structures, R^t, their relative importance in the document, V, and rel-

10   ative position in the documents, L.

Matrix analysis using singular values and singular vectors is well known, for example, in the following publications which describe such matrix analysis: Digital Spectral Analysis with Applications, S.L. Marple, 1987; Matrix Computations, G.H. Golub and C.F. Van Loan, 1989; "Singular Value Decomposition and Least Squares Solutions," Nu-

15   merical Math, G.H. Golub and C. Reisch, 1970; LINPAC User's Guide, J.J. Dongerra, et. al., 1979; and "An Improved Algorithm for Computing Singular Value Decomposition," T.F. Chan, Communications of the ACM, 1982.

Referring again to Figure 3, taking, for example, document N_2, the textual data is represented in a matrix X containing elements arranged in a two-dimensional format

20   with each row corresponding to a single sentence and the elements in each row corresponding to the relative importance of the textual pattern in the text, based on a lexical dictionary or other text-to-numeric translation. This matrix can be decomposed, as described in the above references, into singular vectors and singular values. The right singular vectors are arranged in the rows of the matrix R^t and describe textual features in terms of their lexical,

25   semantic, and/or textual structures. The left singular vectors are arranged in the columns of the matrix L, which describe the textual features in terms of their position within the documents. The singular values are arranged along the principal diagonal in the matrix V and describe the magnitude of the associated textual features. Textual information in the matrix X, which contains a numeric form of input textual data, can be represented by its singular

30   vectors, L and R^t, and its singular values, V. The relative importance of the raw textual data thus can be represented in a substantially compressed form.

The singular values and/or singular vectors are used by the real-time multi-dimensional text processing system of the present invention to monitor, analyze, compare,

1   and enhance and/or suppress features within the textual matrix, X. The right singular vectors, R^t, correspond to textual structures and may be used for the identification and analysis of textual features of interest. The left singular vectors, L, correspond to the relative location of the associated textual features within the matrix X. The singular values, V, are displayed in a diagonal form and may be modified to enhance or suppress the importance of selected singular vectors.

        The left singular vectors, L, right singular vectors, R^t, and singular values, V, are used to represent important features within the input data, but in a substantially compressed form. This allows the data to be easily indexed, analyzed, and visualized; however, saving substantial amounts of effort and computing time. This compression can reach as much as 98% of the original input data.

        In the preferred embodiment of the present invention, the data processing system uses SVD to describe textual features, to suppress or remove unwanted features, and to identify, isolate and visualize features of interest. It also is contemplated that eigenvector decomposition (EVD) of the cross-product matrix of the matrix X may be used. The cross-product of the data matrix X is either $X^t X$ or XX^t. Eigenvector decomposition is also well known in the prior art.

        As discussed, the present invention converts and stores data from textual sources in matrix format. Each document or textual matrix would be converted into two-dimensional numeric form, with the dimensions being sentence structure by position within the document. Alternatively, the textual data may be reformatted into other forms or formats. As shown in Figure 2, the two-dimensional matrices are stacked together, creating an textual "data cube." The dimensions of this three-dimensional data cube are sentence structure by position by document. The relative importance of the textual material can be determined by visualizing (or reading) the value stored in the data cube at any given sentence location, textual segment, and document.

        Referring to Figure 4, a flow chart for operation of the present invention is shown. According to the flow chart, textual data is received and modified by the Preprocessing Function. This modification is to change it from a textual to numeric form. In doing so, the textual data is reformatted and concatenated together along with historical data into a two-dimensional matrix. Next, the two-dimensional data matrix is decomposed by the Subspace Processing Function, for example, into its singular values and singular vectors. Following this, selected results of the Subspace Processing Function are passed to the Analysis

1   Function within the Visualization & Analysis Function, where they may be analyzed further
(for example, with text queries) and/or expanded into their full matrix form for visual dis-
play. Finally, the results of the Analysis Function are passed onto the Data Visualization
Function within the Visualization & Analysis Function, where the results are visualized, for
5   example, as opaque objects within a three-dimensional data cube.

Referring again to Figure 4, in other embodiments of the present invention,
the results of Subspace Processing, in the form of left singular vectors, right singular vec-
tors, and/or singular values, may be transmitted to a remote location for storage, retrieval,
analysis, and display, such as that which would be associated with a database query.

10   Also, according to the system of the present invention, the textual informa-
tion is passed in a forward direction through these functions, information is also passed
back to assist in enhancement and monitoring features of interest. The data that is passed
back is historical data in compressed form.

Historical data consists of a special set of lexical, semantic, and/or textual
15   features of interest, which have been previously calculated by the Subspace Processing
Function. The historical data is passed back to the Preprocessing Function to be concatenat-
ed with new textual data. The purpose of this feedback is to reinforce features of interest to
the point where such features of interest may be enhanced and further distinguished from
background material (i.e., "noise").

20   The Preprocessing Function.

Figure 5 shows the Preprocessing Function in greater detail. This Function
modifies the input textual data and translates it into numeric form. The textual data is
checked for spelling errors and corrected where necessary. Prefixes and/or suffixes are iden-
tified and eliminated, if required. This information also is passed forward to the Alpha-Nu-
25   meric Translation Function to guide subsequent weighting of the data. In addition,
punctuation, italized, and emboldened words are identified and this information is similarly
passed on for subsequent weighting. Information concerning tables, figures, and lists also
is passed on to the Alpha-Numeric Translation Function.

A thesaurus or comparable dictionary is used to modify the text into a user-
30   selectable "standard" semantic form, for example, using synonyms (similarity), hyponyms
(inclusion), antonyms (opposites - for plus/minus weighting), etc.

Thereafter, the sentences are transformed into a more structured, syntactic
form, such as S-V-O (i.e., subject, verb, object), or other comparable formats. For example,

1 the modified text is then converted into numeric form, using a lexical dictionary in which, for each word, there is a corresponding number to reflect its relative importance. This lexical dictionary may vary in composition. For example, one form of lexical dictionary is based on the relative frequency of the word in common usage. In this case, the correspond-

5 ing value reflects the uniqueness of the word. As such, the less common the word, the greater its numeric value. Such a lexical dictionary tends to emphasize relatively rare or unique words, phrases, etc. In an alternative embodiment, other user-selectable lexical dictionaries may be chosen, for example, to give greater emphasis to certain, user-selected keywords and phrases. Furthermore, the user can indicate certain terms, phrases, and/or sections of

10 the document to be enhanced or suppressed.

The final step in the Preprocessing Function is to concatenate the text matrices, N, along with history data, H, which are the right singular vectors of textual features of interest, or textual features not of interest from prior analyses.

It also is understood that other formats may be used and still be within the

15 scope of the present invention. For instance, the numeric matrix can be in other formats, such as a series of numbers to represent a matrix element.

History Data

Historical data for features of interest, R^t_{fi}, and features not of interest, R^t_{fn}, are continuously updated by the Subspace Processing Function and are passed back to the

20 Preprocessing Function. The history data of features of interest are in the form of right singular vectors, R^t_{fi}, which are determined through analysis of the singular values or other predetermined criteria in the Subspace Processing Function or Visualization & Analysis Function and represent highly compressed representations of textual information. The historical data of the features of interest R^t_{fi}, and features not of interest, R^t_{fn}, are scaled and

25 concatenated with the weighted textual data in the two-dimensional data matrix. Alternatively, the historical data also may be selected by the Visualization & Analysis Function. The history database contains historical data that shows the status of the textual data from previous analyses or documents.

Referring to Figure 6, the history database is updated by storing the most re-

30 cently received history data of features of interest, $R^t_{fi.000}$, and features not of interest, $R^t_{fn.000}$. Every subsequent time interval, the history data of features of interest, $R^t_{fi.000}$, are "passed back," or stored in the database to represent the recent historical status of the textual data. This data then becomes $R^t_{fi.001}$. In a similar manner, $R^t_{fi.001}$ is passed back and be-

1   comes $R^t_{fi.002}$, and so on. History data of features not of interest, R^t_{fn}, are maintained and
     updated in a similar manner.

            The present invention creates and maintains historical databases, which is
     efficiently maintained in compressed and enhanced form, and represents the textual data
5   from previous analyses or documents. Each new analysis includes the compressed and en-
     hanced historical data, which is equivalent to a complete analysis of the full (uncom-
     pressed) historical data, yet at a fraction of the computational cost.

            Referring again to Fig 4, after obtaining a combination of concatenated data
     and compressed history in the form of a two-dimensional matrix, the Subspace Processing
10   Function performs a singular value decomposition of the two-dimensional matrix.

            Figure 7 shows the Subspace Processing Function in greater detail. The Sub-
     space Processing Function computes singular vectors and singular values of the matrix X.
     After this, the singular vectors are classified into subspaces based on the magnitudes of their
     corresponding singular values or by some other predetermined criteria. In the preferred em-
15   bodiment, singular vectors are classified into one of three general categories: features of in-
     terest; features not of interest; and other, unimportant features (i.e., "noise"). There may be
     different subspace categories in alternative embodiments. Furthermore, in alternative em-
     bodiments, preliminary classifications may occur in the Subspace Processing Function,
     while additional classifications may occur in the Visualization & Analysis Function.

20   Visualization & Analysis Function

            Referring again to Figure 4, after processing by the Subspace Processing
     Function, the compressed textual data is passed on to the Visualization & Analysis Func-
     tion. This function performs analysis, expansion, visualization, and interpretation of the ex-
     panded textual data as shown in Figure 8. This involves an expansion, visualization, and
25   review of features of interest characterized by the right singular vectors, R^t. In alternative
     embodiments, features not of interest may be simularly expanded visualized, and reviewed.
     According to the preferred embodiment, the left and right singular vectors, L and R^t, and
     modified singular values, V_{enh}, are expanded into their full, enhanced matrix form, X_{enh}:

$$X_{enh} = L \, V_{enh} \, R^t$$

30   The enhanced matrix X_{enh} is then separated into documents and reformatted into a three-
     dimensional data cube.

            Figure 9 shows the three-dimensional data cube that is visually displayed.
     The features of interest may be viewed as opaque features in a transparent cube. In this man-

1   ner a user can quickly review the visual representation of many documents in the document database with regard to what he or she desires to see.

The three-dimensional cube can be rotated and displayed from different perspectives or sliced along a plane within the data cube. The transparent cube contains en-

5   hanced three-dimensional data, and displays features in text matrix format. In other embodiments, the enhanced data may be thresholded, or otherwise modified.

The screen display includes cursors, which allow a user to freely "travel" through the cube, displaying the textual data in any document as a "slice," or plane, through the cube.

10   The user interprets a particular structure by selecting a representative slice and the corresponding documentation in the form of the associated structured textual matrix and/or associated document.

<u>Database Query</u>

Referring again to Figure 8, a second form of analysis of the data is shown.

15   Database query involves a query into what a user is looking for regarding a subject of interest. The preferred method of the present invention is illustrated to Figure 10.

Referring to Figure 10, the user would highlight those portions of the text which referred to a topic or topics of interest. This would ensure that these sections would be given more weight in subsequent processing. The user also could input keywords, phras-

20   es, short descriptions, or other textual material to condition the query.

The user would use the present invention to analyze a numeric form of the article of interest, X_i, according to the process outlined in Figure 4. The resulting left singular vectors, L_i, would indicate the relative location of the subject material in the text matrix associated with the topic of interest and would be used to identify a subset of the right

25   singular vectors, S_i^t, which indicates the subject matter of interest. Thus, the singular vectors, S_i^t, represent a database query in a format automatically tailored for the rapid analysis of a full database of documents.

Referring again to Figure 3, in the preferred embodiment, the document database would have been previously analyzed according to the present invention and would

30   have an associated matrix of right singular values, R^t, which would characterize the lexical, semantic, and/or textual structure of the database. In the present invention, the user would "search" this compressed history of documents for similar structures, through the matrix operation:

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$$R_s^t = (R^t S_i) S_i^t,$$

where $(R^t S_i)$ represents the correlation between the subject material of interest S_i and the full, compressed data set, R^t. The resulting matrix R_s^t represents those structures within the full database which are correlated with the subject material of interest. In addition, the user

5   could further modify the singular values in V_i to enhance features of interest, to suppress features not of interest, or to suppress or eliminate unimportant material ("noise"). The user also could further modify the singular vectors themselves, for example, through thresholding to provide predetermined effects.

Again referring to Figure 9, the user can expand, visualize, and interpret the

10   results of the "search" contained in R_s^t. Those documents with the most coverage of the subject of interest would visually stand out as opaque features within the data cube. The user would be able to quickly assess the number of documents containing the subject matter of interest and the detail of coverage.

Figure 11 shows an alternative embodiment in which a document containing

15   subject matter of interest, S, would be concatenated to the document matrix, X. In the Subspace Processing Function, the left singular vectors associated with S (i.e., L_s) would indicate which structures describe features of interest. Furthermore, by scanning down the remaining left singular vectors, L_x, the user could quickly assess which other documents also contain the subject matter.

20   <u>Identify New Information</u>

Referring again to Figures 8 and 11, after the data query has been and processed, the user could quickly identify those articles which represent new information in the matrix X. Accordingly, after Subspace Processing, the matrix L_h represents the correlation between lexical, semantic, and/or textual features in X and features of interest, H, from pri-

25   or analyses. Those left singular vectors, L_h, with low correlation values (i.e., L_{new}, a subset of L_x, L_h) would indicate that there were features in the new data which were different (i.e., weakly correlated, or uncorrelated) from past articles. Thus, the corresponding right singular vectors (i.e., R_{new}^t) would represent the sentence structures associated with these new features. Consequently, this data may be isolated, enhanced, and visualized by passing the

30   matrices L_{new}, V_{new}, and R_{new}^t back to the Visualization & Interpretation Function.

The terms and expressions that are employed herein are terms or description and not of limitation. There is no intention in the use of such terms and expressions of excluding the equivalents of the feature shown or described, or portions thereof, it being

-12-

1   recognized that various modifications are possible within the scope of the invention as

claimed.

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Claims:

1.   A system for at least enhancing selected information contained in a
data containing media, comprising:

    input means for inputting data to the system;

    first processing means that receives the data input from the input means, the
first processing means for converting the input data from a first form to a second form;

    second processing means for receiving an output of the first processing
means, the second processing means for compressing the converted input data into com-
pressed data structures, with the compressed data structures having information regarding
a location and an importance of each element in the input data, and with at least a subset of
the compressed data structures being enhanced with respect to a remainder of the com-
pressed data structures by modifying at least the subset of the compressed data structures;

    third processing means for receiving an output of the second processing
means, the third processing means for expanding the compressed data structures, with the
subset of the compressed data structures enhanced, to a full form of data structures, the full
form of data structures being representative of the converted input data with enhanced data
structures being distinguishable from a remainder of data structures; and

    readable form means for receiving an output of the third processing means,
the readable form means for providing in readable form the full form of data structures
representative of the converted input data, with the enhanced data structures being repre-
sented differently than the remainder of data structures by the readable form means.

2.   The system as recited in claim 1, wherein the input data includes
input textual data.

3.   The system as recited in claim 1, wherein the first processing means
further includes means for converting the input data into at least a two-dimensional matrix.

4.   The system as recited in claim 3, wherein the first processing means
further includes means for converting the input data into at least a two-dimensional
numeric matrix.

5.   The system as recited in claim 3, wherein the second processing
means further includes means for decomposing the two-dimensional matrix into com-
pressed data structures representative of the two-dimensional matrix, with the compressed

data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying the subset of the compressed data structures.

6. The system as recited in claim 5, wherein the two-dimensional matrix is decomposed using singular value decomposition.

7. The system as recited in claim 5, wherein the two-dimensional matrix is decomposed using eigenvector decomposition.

8. The system as recited in claim 1, wherein the first processing means adds historical data to the input data in converting the input data from the first form to the second form.

9. The system as recited in claim 1, wherein the readable form means includes a display means.

10. A system for at least enhancing and suppressing selected information contained in data containing media, comprising:

input means for inputting data to the system;

first processing means that receives the data input from the input means, the first processing means for converting the input data from a first form to a second form;

second processing means for receiving an output of the first processing means, the second processing means for compressing the converted input data into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the input data, and with at least a first subset of the compressed data structures being enhanced and a second subset of the compressed data structures being suppressed with respect to a remainder of the compressed data structures by modifying at least the first and second subsets of the compressed data structures;

third processing means for receiving an output of the second processing means, the third processing means for expanding the compressed data structures, with the first and second subsets of the compressed data structures enhanced and suppressed, respectively, to a full form of data structures, the full form of data structures being representative of the converted input data with enhanced and suppressed data structures being

distinguishable from a remainder of data structures; and

readable form means for receiving an output of the third processing means, the readable means for providing in readable form the full form of the data structures representative of the converted input data, with the enhanced and suppressed data structures being represented differently than the remainder of data structures by the readable form means.

11. The system as recited in claim 10, wherein the input data includes input textual data.

12. The system as recited in claim 10, wherein the first processing means further includes means for converting the input data into at least a two-dimensional matrix.

13. The system as recited in claim 12, wherein the first processing means further includes means for converting the input data into at least a two-dimensional numeric matrix.

14. The system as recited in claim 12, wherein the second processing means further includes means for decomposing the two-dimensional matrix into compressed data structures representative of the two-dimensional matrix, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least the first subset of the compressed data structures being enhanced and the second subset of the compressed data structures being suppressed with respect to a remainder of the compressed data structures by modifying at least the first and second subsets of the compressed data structures.

15. The system as recited in claim 14, wherein the two-dimensional numeric matrix is decomposed using singular value decomposition.

16. The system as recited in claim 14, wherein the two-dimensional matrix is decomposed using eigenvector decomposition.

17. The system as recited in claim 10, wherein the first processing means adds historical data to the input data in converting the input data from the first form to the second form.

18. The system as recited in claim 10, wherein the readable form means includes a display means.

19. A system for at least enhancing selected information contained in data

containing media, comprising:

input means for inputting data into the system;

first processing means that receives the data input from the input means, the first processing means for converting the input data from a first form to a three-dimensional matrix and for converting the three-dimensional matrix to a two-dimensional matrix;

second processing means for receiving an output of the first processing means, the second processing means for compressing the two-dimensional matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

third processing means for receiving an output of the second processing means, the third processing means for expanding the compressed data structures, with the subset of the compressed data structures enhanced, to a full form of data structures, the full form of data structures being representative of the converted input data, with the enhanced data structures being distinguishable from a remainder of data structures; and

readable form means for receiving an output of the third processing means, the readable form means for providing the full form of data structures representative of the converted input data, with the enhanced data structures being represented differently than the remainder of data structures by the readable form means.

20.   The system as recited in claim 19, wherein the input data includes input textual data.

21.   The system as recited in claim 19, wherein the first processing means further includes means for converting the three-dimensional matrix into a two-dimensional numeric matrix.

22.   The system as recited in claim 21, wherein the second processing means further includes means for decomposing the two-dimensional numeric matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional numeric

matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures.

23.   The system as recited in claim 22, wherein the two-dimensional numeric matrix is decomposed using singular value decomposition.

24.   The system as recited in claim 22, wherein the two-dimensional numeric matrix is decomposed using eigenvector decomposition.

25.   The system as recited in claim 21, wherein the first processing means converts the three-dimensional matrix into the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix to form the two-dimensional numeric matrix.

26.   The system as recited in claim 25, wherein the first processing means converts the three-dimensional matrix to the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix and historical data to form the two-dimensional numeric matrix.

27.   The system as recited in claim 19, wherein the readable form means includes a display means.

28.   A system for at least enhancing selected information contained in a data containing media, comprising:

    input means for inputting data to the system;

    first processing means that receives the data input from the input means and adds historical data to the input data, the first processing means for converting the input data and historical data from a first form to a second form;

    second processing means for receiving an output of the first processing means, the second processing means for compressing the converted input data and historical data into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element in the input data and historical data, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

    storage means for receiving and storing the compressed data structures out-

put from the second processing means;

query means that connects to the storage means, the query means for identi-
fying compressed data structures in the storage means that have at least a predetermined
correlation with the subset of the compressed data structures;

third processing means for retrieving from the storage means the subset of
the compressed data structures and the compressed data structures that have at least the
predetermined correlation with the subset of compressed data structures, expanding to a
full form of data structures at least the subset of the compressed data structures; and

readable form means for receiving an output of the third processing means,
the readable form means for providing in readable form the full form of data structures
representative of the subset of the compressed data structures.

29.   The system as recited in claim 28, wherein the input data includes
input textual data.

30.   The system as recited in claim 28, wherein the first processing means
further includes means for converting the input data and historical data into at least a two-
dimensional matrix.

31.   The system as recited in claim 30, wherein the first processing means
further includes means for converting the input data and historical data into at least a two-
dimensional numeric matrix.

32.   The system as recited in claim 30, wherein the second processing
means further includes means for decomposing the two-dimensional matrix into com-
pressed data structures representative of the two-dimensional matrix, with the compressed
data structures having information regarding a location and an importance of each element
of the two-dimensional matrix, and with at least the subset of the compressed data struc-
tures being enhanced with respect to a remainder of the compressed data structures by
modifying the subset of the compressed data structures.

33.   The system as recited in claim 32, wherein the two-dimensional
matrix is decomposed using singular value decomposition.

34.   The system as recited in claim 32, wherein the two-dimensional
matrix is decomposed using eigenvector decomposition.

35.   The system as recited in claim 28, wherein the readable form means

includes a display means.

36.   The system as recited in claim 28, wherein the third processing means includes means for expanding to the full form of data structures at least the subset of compressed data structures and the identified compressed data structures that have the predetermined correlation with the subset of the compressed data structures.

37.   The system as recited in claim 36, wherein the readable form means includes means for providing in readable form the full form of data structures representative of the subset of compressed data structures and the identified compressed data structures that have the predetermined correlation with the subset of the compressed data structures.

38.   A system for at least enhancing selected information contained in data containing media, comprising:

input means for inputting data into the system;

first processing means that receives the data input from the input means and adds historical data to the input data, the first processing means for converting the input data and historical data from a first form to a three-dimensional matrix and for converting the three-dimensional matrix to a two-dimensional matrix;

second processing means for receiving an output of the first processing means, the second processing means for compressing the two-dimensional matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

storage means for receiving and storing the compressed data structures output from the second processing means;

query means that connect to the storage means, the query means for identifying compressed data structures in the storage means that have at least a predetermined correlation with the subset of the compressed data structures;

third processing means for retrieving from the storage means the subset of the compressed data structures and the compressed data structures that have at least the

predetermined correlation with the subset of compressed data structures, expanding to a full form of data structures at least the subset of the compressed data structures; and

readable form means for receiving an output of the third processing means, the readable form means for providing in readable form the full form of data structures representative of the subset of the compressed data structures.

39.   The system as recited in claim 38, wherein the input data includes input textual data.

40.   The system as recited in claim 38, wherein the first processing means further includes means for converting the three-dimensional matrix into a two-dimensional numeric matrix.

41.   The system as recited in claim 40, wherein the second processing means further includes means for decomposing the two-dimensional numeric matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional numeric matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures.

42.   The system as recited in claim 41, wherein the two-dimensional numeric matrix is decomposed using singular value decomposition.

43.   The system as recited in claim 41, wherein the two-dimensional numeric matrix is decomposed using eigenvector decomposition.

44.   The system as recited in claim 40, wherein the first processing means converts the three-dimensional matrix into the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix to form the two-dimensional numeric matrix.

45.   The system as recited in claim 44, wherein the first processing means converts the three-dimensional matrix to the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix and historical data to form the two-dimensional numeric matrix.

46.   The system as recited in claim 38, wherein the readable form means includes a display means.

47.   The system as recited in claim 38, wherein the third processing means includes means for expanding to the full form of data structures at least the subset of compressed data structures and the identified compressed data structures that have the predetermined correlation with the subset of the compressed data structures.

48.   The system as recited in claim 47, wherein the readable form means includes means for providing in readable form the full form of data structures representative of the subset of compressed data structures and the identified compressed data structures that have the predetermined correlation with the subset of the compressed data structures.

49.   A system for at least enhancing selected information contained in data containing media, comprising:

input means for inputting data into the system;

first processing means that receives the data input from the input means and adds historical data to the input data, the first processing means for converting the input data and historical data from a first form to a three-dimensional matrix and for converting the three-dimensional matrix to a two-dimensional matrix;

second processing means for receiving an output of the first processing means, the second processing means for compressing the two-dimensional matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

storage means for receiving and storing the compressed data structures output from the second processing means;

query means that connect to the storage means, the query means for searching the compressed data structures in the storage means that have at least the predetermined correlation with the subset of the compressed data structures;

comparator for determining differences between the subset of the compressed data structures and the compressed data structures identified by the query means;

third processing means for retrieving from the storage means the subset of

the compressed data structures and the compressed data structures that have a predeter-
mined correlation with the subset of compressed data structures, expanding to a full form
of data structures at least the subset of the compressed data structures; and

        readable form means for receiving an output of the third processing means,
the readable form means for providing in readable form the full form of data structures
representative of the subset of the compressed data structures.

        50.   The system as recited in claim 49, wherein the input data includes
input textual data.

        51.   The system as recited in claim 49, wherein the first processing means
further includes means for converting the three-dimensional matrix into a two-dimensional
numeric matrix.

        52.   The system as recited in claim 51, wherein the second processing
means further includes means for decomposing the two-dimensional numeric matrix into
compressed data structures, with the compressed data structures having information
regarding a location and an importance of each element of the two-dimensional numeric
matrix, and with at least the subset of the compressed data structures being enhanced with
respect to a remainder of the compressed data structures by modifying at least the subset of
the compressed data structures.

        53.   The system as recited in claim 52, wherein the two-dimensional
numeric matrix is decomposed using singular value decomposition.

        54.   The system as recited in claim 52, wherein the two-dimensional
numeric matrix is decomposed using eigenvector decomposition.

        55.   The system as recited in claim 51, wherein the first processing means
converts the three-dimensional matrix into the two-dimensional numeric matrix by concat-
enating predetermined elements of the three-dimensional matrix to form the two-dimen-
sional numeric matrix.

        56.   The system as recited in claim 55, wherein the first processing means
converts the three-dimensional matrix to the two-dimensional numeric matrix by concate-
nating predetermined elements of the three-dimensional matrix and historical data to form
the two-dimensional numeric matrix.

        57.   The system as recited in claim 49, wherein the readable form means

includes a display means.

58.   The system as recited in claim 49, wherein the third processing means includes means for expanding to the full form of data structures at least the subset of compressed data structures and the differences between the subset of the compressed data structures and compressed data structures identified by the query means.

59.   The system as recited in claim 58, wherein the readable form means includes means for providing in readable form the full form of data structures representative of the subset of compressed data structures and the differences between the subset of the compressed data structures and compressed data structures identified by the query means.

60.   A system for at least enhancing selected information contained in a data containing media, comprising:

input means for inputting data to the system;

first processing means that receives the data input from the input means and adds historical data to the input data, the first processing means for converting the input data and historical data from a first form to a second form;

second processing means for receiving an output of the first processing means, the second processing means for compressing the converted input data and historical data into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element in the input data and historical data, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

storage means for receiving and storing the compressed data structures output from the second processing means;

query means that connects to the storage means, the query means for identifying compressed data structures in the storage means that have at least the predetermined correlation with the subset of the compressed data structures;

comparator for determining differences between the subset of the compressed data structures and the compressed data structures identified by the query means;

third processing means for retrieving from the storage means the subset of

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the compressed data structures and the compressed data structures that have a predeter-mined correlation with the subset of compressed data structures, expanding to a full form of data structures at least the subset of the compressed data structures; and

readable form means for receiving an output of the third processing means, the readable form means for providing in readable form the full form of data structures representative of the subset of the compressed data structures.

61. The system as recited in claim 60, wherein the input data includes input textual data.

62. The system as recited in claim 60, wherein the first processing means further includes means for converting the input data into at least a two-dimensional matrix.

63. The system as recited in claim 62, wherein the first processing means further includes means for converting the input data and historical data into at least a two-dimensional numeric matrix.

64. The system as recited in claim 63, wherein the second processing means further includes means for decomposing the two-dimensional matrix into com-pressed data structures representative of the two-dimensional matrix, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least the subset of the compressed data struc-tures being enhanced with respect to a remainder of the compressed data structures by modifying the subset of the compressed data structures.

65. The system as recited in claim 64, wherein the two-dimensional matrix is decomposed using singular value decomposition.

66. The system as recited in claim 64, wherein the two-dimensional matrix is decomposed using eigenvector decomposition.

67. The system as recited in claim 60, wherein the readable form means includes a display means.

68. The system as recited in claim 60, wherein the third processing means includes means for expanding to the full form of data structures at least the subset of com-pressed data structures and the differences between the subset of the compressed data structures and the compressed data structures identified by the query means.

69. The system as recited in claim 68, wherein the readable form means

includes means for providing in readable form the full form of data structures representa-
tive of the subset of compressed data structures and the differences between the subset of
the compressed data structures and the compressed data structures identified by the query
means.

70.   A method for at least enhancing selected information contained in a
data containing media using a computer based system, comprising the steps of:

inputting data to the system;

processing the input data with first processing means for converting the
input data from a first form to a second form;

processing an output of the first processing means with second processing
means for compressing the converted input data into compressed data structures, with the
compressed data structures having information regarding a location and an importance of
each element in the input data, and with at least a subset of the compressed data structures
being enhanced with respect to a remainder of the compressed data structures by modify-
ing at least the subset of the compressed data structures;

processing an output of the second processing means with
third processing means for expanding the compressed data structures, with the subset of
the compressed data structures enhanced, to a full form of data structures, the full form of
data structures being representative of the converted input data with enhanced data struc-
tures being distinguishable from a remainder of data structures; and

generating from an output of the third processing means a readable form of
the full form of data structures representative of the converted input data, with the
enhanced data structures being represented differently than the remainder of data struc-
tures.

71.   The method as recited in claim 70, wherein processing with the first
processing means further includes converting the input data into at least a two-dimensional
matrix.

72.   The method as recited in claim 71, wherein processing with the first
processing means further includes converting the input data into at least a two-dimensional
numeric matrix.

73.   The method as recited in claim 71, wherein processing with the sec-

ond processing means further includes decomposing the two-dimensional matrix into compressed data structures representative of the two-dimensional matrix, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying the subset of the compressed data structures.

74. The method as recited in claim 73, wherein decomposing includes decomposing using singular value decomposition.

75. The method as recited in claim 73, wherein decomposing includes decomposing using eigenvector decomposition.

76. The method as recited in claim 70, wherein processing with the first processing includes adding historical data to the input data in converting the input data from the first form to the second form.

77. A method for at least enhancing selected information contained in data containing media using a computer based system, comprising the steps of :

inputting data into the system;

processing the input data with first processing means for converting the input data from a first form to a three-dimensional matrix and for converting the three-dimensional matrix to a two-dimensional matrix;

processing an output of the first processing means with second processing means for compressing the two-dimensional matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

processing an output of the second processing means with third processing means for expanding the compressed data structures, with the subset of the compressed data structures enhanced, to a full form of data structures, the full form of data structures being representative of the converted input data, with the enhanced data structures being distinguishable from a remainder of data structures; and

generating from an output of the third processing means a readable form of

the full form of data structures representative of the converted input data, with the enhanced data structures being represented differently than the remainder of data structures.

78.   The method as recited in claim 77, wherein processing with the first processing means further includes converting the three-dimensional matrix into a two-dimensional numeric matrix.

79.   The method as recited in claim 78, wherein processing with the second processing means further includes decomposing the two-dimensional numeric matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional numeric matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures.

80.   The method as recited in claim 79, wherein decomposing including decomposing using singular value decomposition.

81.   The method as recited in claim 79, wherein decomposing includes decomposing using eigenvector decomposition.

82.   The method as recited in claim 79, wherein processing with the first processing means includes converting the three-dimensional matrix into the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix to form the two-dimensional numeric matrix.

83.   The method as recited in claim 82, wherein processing with the first processing means includes converting the three-dimensional matrix to the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix and historical data to form the two-dimensional numeric matrix.

84.   A method for at least enhancing selected information contained in a data containing media using a computer based system, comprising the steps of:

inputting data to the system;

processing the input data with first processing means by adding historical data to the input data and converting the input data and historical data from a first form to a second form;

processing an output the first processing means with second processing means for compressing the converted input data and historical data into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element in the input data and historical data, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

storing in storage means the compressed data structures output from the second processing means;

identifying with query means compressed data structures in the storage means that have at least a predetermined correlation with the subset of the compressed data structures;

retrieving from the storage means the subset of the compressed data structures and the compressed data structures that have at least the predetermined correlation with the subset of compressed data structures;

expanding to a full form of data structures at least the subset of the compressed data structures; and

generating in readable form the full form of data structures representative of the subset of the compressed data structures.

85. The method as recited in claim 84, wherein processing with the first processing means further includes converting the input data and historical data into at least a two-dimensional matrix.

86. The method as recited in claim 85, wherein processing the first processing means further includes converting the input data and historical data into at least a two-dimensional numeric matrix.

87. The method as recited in claim 85, wherein processing with the second processing means further includes decomposing the two-dimensional matrix into compressed data structures representative of the two-dimensional matrix, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by

modifying the subset of the compressed data structures.

88.   The method as recited in claim 87, wherein decomposing includes decomposing using singular value decomposition.

89.   The method as recited in claim 87, wherein decomposing includes decomposing using eigenvector decomposition.

90.   The method as recited in claim 84, wherein expanding includes expanding to the full form of data structures at least the subset of compressed data structures and the identified compressed data structures that have the predetermined correlation with the subset of the compressed data structures.

91.   The method system as recited in claim 90, wherein generating a readable form of the full form of the data structures includes generating in a readable form the full form of data structures representative of the subset of compressed data structures and the identified compressed data structures that have the predetermined correlation with the subset of the compressed data structures.

92.   A method for at least enhancing selected information contained in data containing media using a computer based system, comprising the steps of:

inputting data into the system;

processing the input data with first processing means by adding historical data to the input data and converting the input data and historical data from a first form to a three-dimensional matrix and for converting the three-dimensional matrix to a two-dimensional matrix;

processing an output of the first processing means with second processing means for compressing the two-dimensional matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

storing in storage means the compressed data structures output from the second processing means;

identifying with query means compressed data structures in the storage means that have at least a predetermined correlation with the subset of the compressed

data structures;

retrieving from the storage means the subset of the compressed data structures and the compressed data structures that have at least the predetermined correlation with the subset of compressed data structures;

expanding to a full form of data structures at least the subset of the compressed data structures; and

generating in readable form the full form of data structures representative of the subset of the compressed data structures.

93.   The method as recited in claim 92, wherein processing with the first processing means further includes converting the three-dimensional matrix into a two-dimensional numeric matrix.

94.   The system as recited in claim 93, wherein processing with the second processing means further include decomposing the two-dimensional numeric matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional numeric matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures.

95.   The method as recited in claim 94, wherein decomposing includes decomposing using singular value decomposition.

96.   The method as recited in claim 94, wherein decomposing includes decomposing using eigenvector decomposition.

97.   The method as recited in claim 93, wherein processing with the first processing means including converting the three-dimensional matrix into the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix to form the two-dimensional numeric matrix.

98.   The method as recited in claim 97, wherein processing with the first processing means includes converting the three-dimensional matrix to the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix and historical data to form the two-dimensional numeric matrix.

99.   The method as recited in claim 92, wherein expanding including

expanding to the full form of data structures at least the subset of compressed data struc-
tures and the identified compressed data structures that have the predetermined correlation
with the subset of the compressed data structures.

100. The method as recited in claim 99, wherein generating a readable
form of the full form of the data structures includes generating in a readable form the full
form of data structures representative of the subset of compressed data structures and the
identified compressed data structures that have the predetermined correlation with the sub-
set of the compressed data structures.

101. A method for at least enhancing selected information contained in
data containing media using a computer based system, comprising the steps of:

inputting data into the system;

processing the input data with first processing means by adding historical
data to the input data and converting the input data and historical data from a first form to
a three-dimensional matrix and for converting the three-dimensional matrix to a two-
dimensional matrix;

processing an output of the first processing means with second processing
means for compressing the two-dimensional matrix into compressed data structures, with
the compressed data structures having information regarding a location and an importance
of each element of the two-dimensional matrix, and with at least a subset of the com-
pressed data structures being enhanced with respect to a remainder of the compressed data
structures by modifying at least the subset of the compressed data structures;

storing in storage means the compressed data structures output from the
second processing means;

identifying with query means the compressed data structures in the storage
means that have at least a predetermined correlation with the subset of the compressed
data structures;

comparing the subset of the compressed data structures and the compressed
data structures identified by the query means to determine differences between the subset
of compressed data and the compressed data structures identified by the query means;

retrieving from the storage means the subset of the compressed data struc-
tures and the compressed data structures that have the predetermined correlation with the

subset of compressed data structures;

       expanding to a full form of data structures at least the subset of the compressed data structures; and

       generating in readable form the full form of data structures representative of the subset of the compressed data structures.

       102. The method as recited in claim 101, wherein processing with the first processing means further includes converting the three-dimensional matrix into a two-dimensional numeric matrix.

       103. The system as recited in claim 102, wherein the processing with second processing means further includes decomposing the two-dimensional numeric matrix into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional numeric matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures.

       104. The method recited in claim 103, wherein decomposing includes decomposing using singular value decomposition.

       105. The method as recited in claim 103, wherein decomposing includes decomposing using eigenvector decomposition.

       106. The method as recited in claim 102, wherein processing with the first processing means includes converting the three-dimensional matrix into the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix to form the two-dimensional numeric matrix.

       107. The method as recited in claim 106, wherein processing with the first processing means includes converting the three-dimensional matrix to the two-dimensional numeric matrix by concatenating predetermined elements of the three-dimensional matrix and historical data to form the two-dimensional numeric matrix.

       108. The method as recited in claim 101, wherein expanding includes expanding to the full form of data structures at least the subset of compressed data structures and the differences between the subset of the compressed data structures and compressed data structures identified by the query means.

109. The method as recited in claim 108, wherein generating a readable form of the full form of data structures includes generating in a readable form the full form of data structures representative of the subset of compressed data structures and the differences between the subset of the compressed data structures and compressed data structures identified by the query means.

110. A method for at least enhancing selected information contained in a data containing media using a computer based system, comprising the steps of:

inputting data to the system;

processing the input data with first processing means by adding historical data to the input data and converting the input data and historical data from a first form to a second form;

processing an output of the first processing means with second processing means for compressing the converted input data and historical data into compressed data structures, with the compressed data structures having information regarding a location and an importance of each element in the input data and historical data, and with at least a subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying at least the subset of the compressed data structures;

storing in storage means the compressed data structures output from the second processing means;

identifying with query means compressed data structures in the storage means that have at least the predetermined correlation with the subset of the compressed data structures;

comparing the subset of the compressed data structures and the compressed data structures identified by the query means to determine differences between the subset of compressed data structures and the compressed data structures identified by the query means;

retrieving from the storage means the subset of the compressed data structures and the compressed data structures that have the predetermined correlation with the subset of compressed data structures;

expanding to a full form of data structures at least the subset of the com-

pressed data structures; and

generating in readable form the full form of data structures representative of the subset of the compressed data structures.

111. The method as recited in claim 110, wherein processing with the first processing means further includes converting the input data into at least a two-dimensional matrix.

112. The method system as recited in claim 111, wherein processing with the first processing means further includes converting the input data and historical data into at least a two-dimensional numeric matrix.

113. The method as recited in claim 112, wherein processing with the second processing means further includes decomposing the two-dimensional matrix into compressed data structures representative of the two-dimensional matrix, with the compressed data structures having information regarding a location and an importance of each element of the two-dimensional matrix, and with at least the subset of the compressed data structures being enhanced with respect to a remainder of the compressed data structures by modifying the subset of the compressed data structures.

114. The method as recited in claim 113, wherein decomposing includes decomposing using singular value decomposition.

115. The method as recited in claim 113, wherein decomposing includes decomposing using eigenvector decomposition.

116. The method as recited in claim 110, wherein expanding includes expanding to the full form of data structures at least the subset of compressed data structures and the differences between the subset of the compressed data structures and the compressed data structures identified by the query means.

117. The method as recited in claim 116, wherein generating a readable form of the full form of data structures includes generating in a readable form the full form of data structures representative of the subset of compressed data structures and the differences between the subset of the compressed data structures and the compressed data structures identified by the query means.

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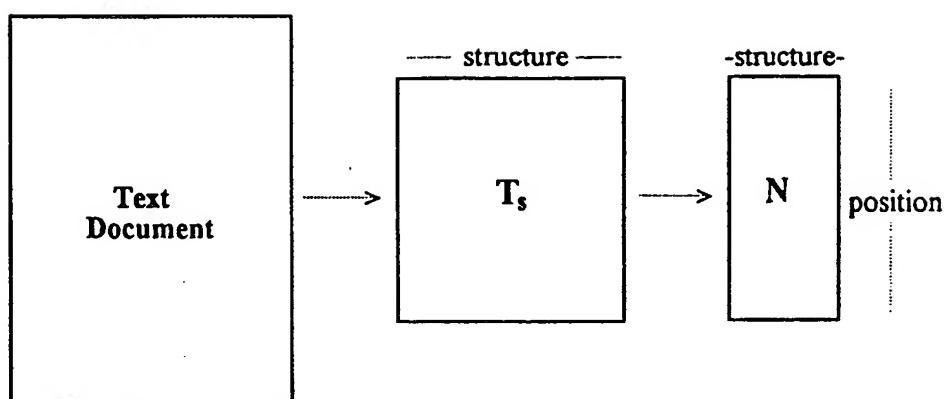
Figure 1

0 2 / 1 1
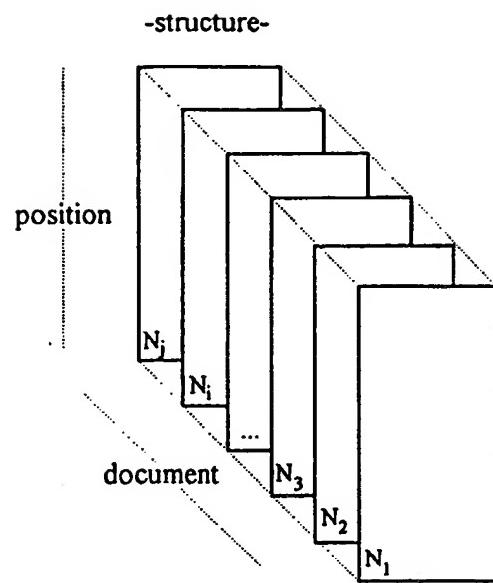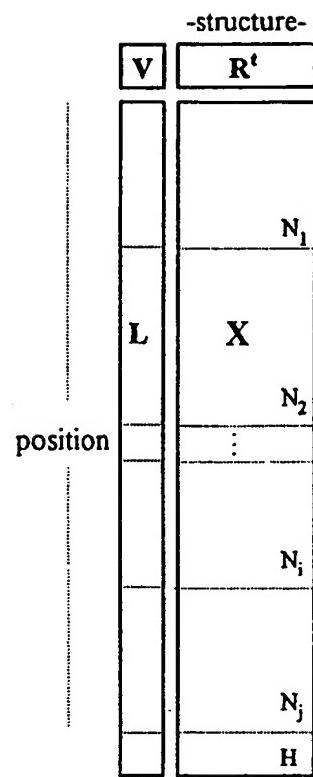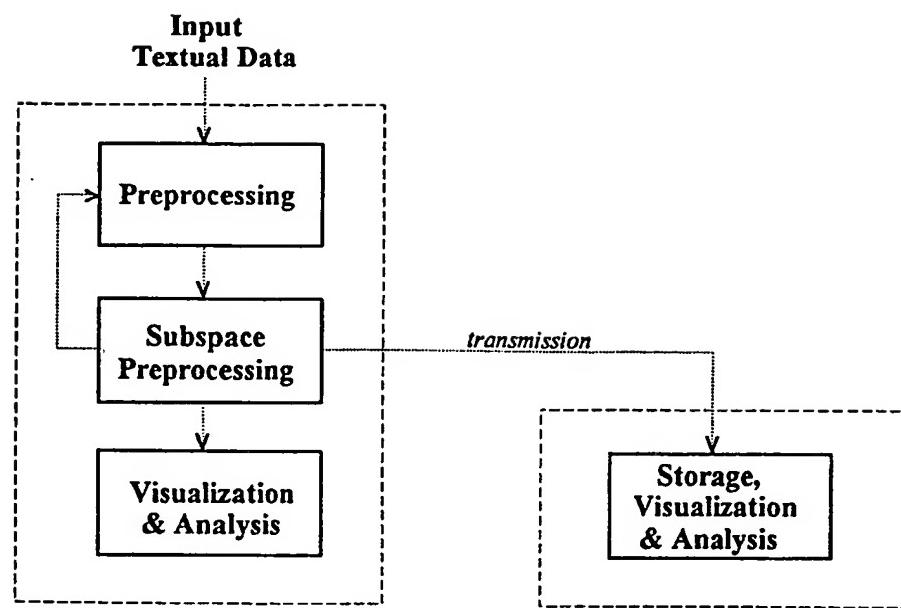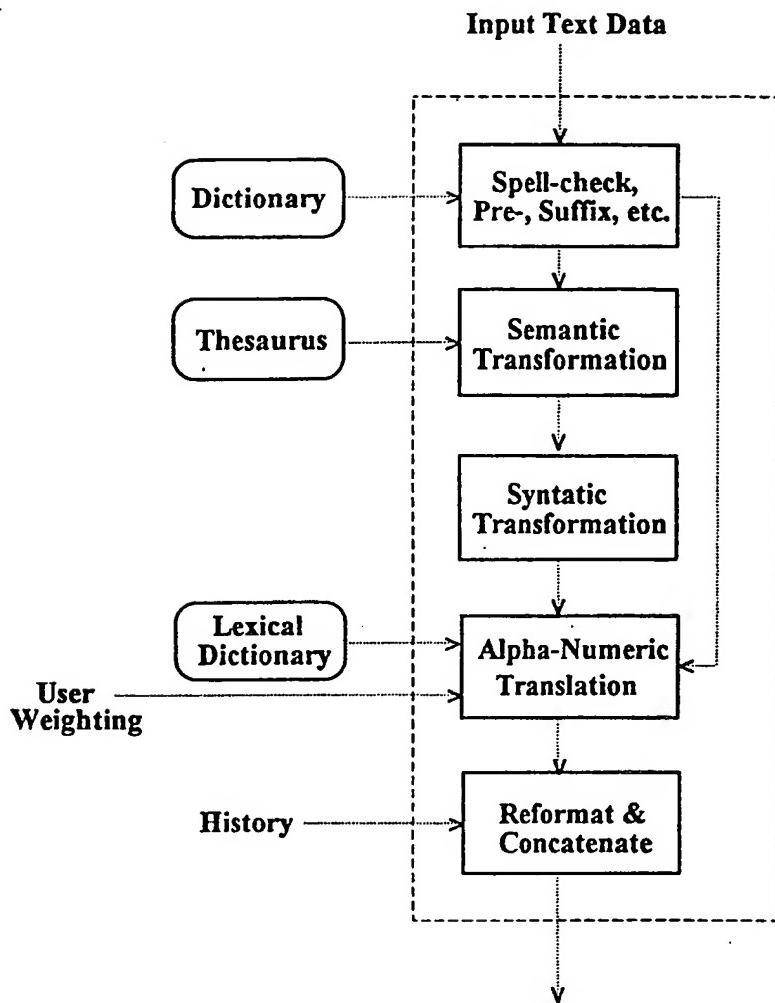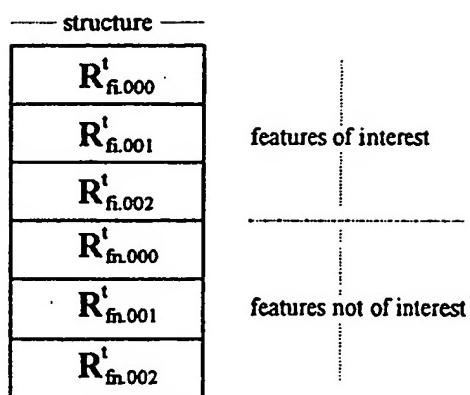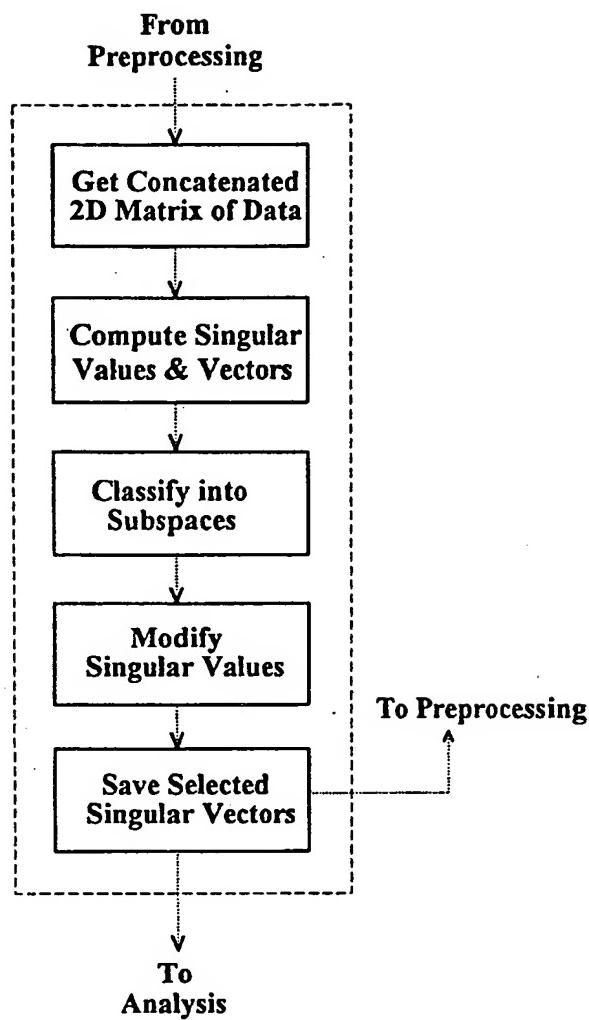
-structure-

position

document

N_j

N_i

...

N_3

N_2

N_1

Figure 2

0 3 / 1 1

Figure 3

Figure 4

0 5 / 1 1

Input Text Data

Dictionary → Spell-check, Pre-, Suffix, etc.

Thesaurus → Semantic Transformation

Syntatic Transformation

Lexical Dictionary → Alpha-Numeric Translation

User Weighting →

History → Reformat & Concatenate

Figure 5

—— structure ——

$R^t_{fi.000}$
$R^t_{fi.001}$
$R^t_{fi.002}$
$R^t_{fn.000}$
$R^t_{fn.001}$
$R^t_{fn.002}$

features of interest

features not of interest

Figure 6

From
Preprocessing

Get Concatenated
2D Matrix of Data

Compute Singular
Values & Vectors

Classify into
Subspaces

Modify
Singular Values

To Preprocessing

Save Selected
Singular Vectors

To
Analysis

Figure 7

$$L, V_{enh}, R^t$$

Figure 8

Figure 9

-structure-
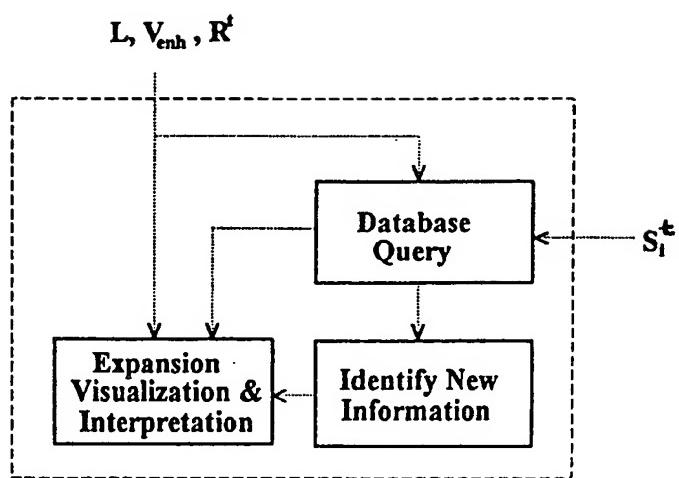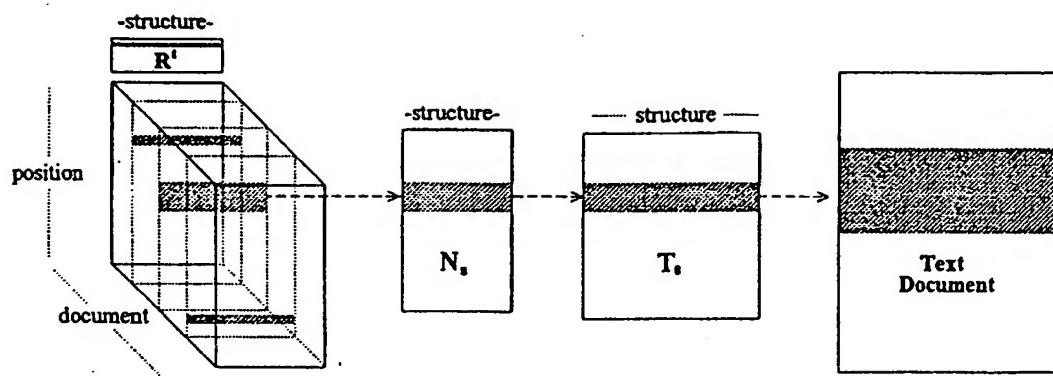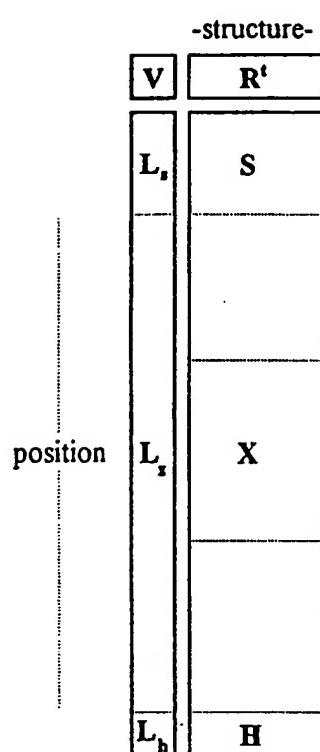
Figure 11

A.   CLASSIFICATION OF SUBJECT MATTER

IPC(6)   :G09G 5/26

US CL   :395/145, 151

According to International Patent Classification (IPC) or to both national classification and IPC

B.   FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. :   395/145, 151, 150, 161

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C.   DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5,274,365 (MARTINEZ ET AL) 28 December 1993, col.1, lines 30-34; col.6, line 23 through col.8, line 24; col.14, line 45 through col.27, line 14; figs.3 and 12.	1-117
A	US, A, 5,241,653 (COLLINS ET AL) 31 August 1993	1-117
A	US, A, 5,189,730 (KAJIMOTO) 23 February 1993	1-117
A	US, A, 5,150,460 (ONODERA ET AL) 22 September 1992	1-117

☐   Further documents are listed in the continuation of Box C.   ☐   See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance		
"E"	earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)		
		"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 JUNE 1995	1 2 SEP 1995

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	HEATHER R. HERNDON
Facsimile No. (703) 305-3230	Telephone No. (703) 305-9701

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